SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

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AN ENGINEERING MODEL TO DESCRIBE FRAGMENTS CLOUDS PROPAGATING INSIDE SPACECRAFT IN CONSEQUENCE OF SPACE DEBRIS IMPACT ON SANDWICH PANEL STRUCTURES

Abstract

All spacecraft in Earth orbit are exposed to the risk of impact with micrometeoroids and orbital debris. When such particles have enough energy to penetrate the hull of the vehicle, clouds of fragments are ejected into the spacecraft interior and they can eventually compromise the functionality of various components in their flight path; knowledge of the clouds' properties (e.g. fragments mass and velocity) is therefore a key factor to obtain accurate predictions of the response of interior equipment to space debris threat. However, generation and evolution of debris clouds from hypervelocity impact is a complex phenomenon governed by a large number of parameters and existing models mostly refer to fragments originated by impact on simple aluminium plates, while the few models available for sandwich panels do not provide information on the fragments mass. In such context, this paper presents an engineering model describing debris clouds created by space debris impacts on honeycomb sandwich panels representative of satellites structural bodies. The model consists of a set of empirical equations providing three pieces of information, i.e. the geometric description of the cloud, the velocity distribution and the mass distribution of the fragments. The proposed equations are derived from analogous formulas for debris clouds originated by impacts on simple aluminium plates, by applying proper corrections to account for different materials' effects and different behavior of sandwich panels compared to plates of same material. The model is finally evaluated by comparing its predictions with those of available models for honeycomb sandwich panels (in this case, only clouds geometry and tip velocity could be assessed) and few experimental data (in this case the fragments mass distribution was inferred from damage patterns on witness plates placed behind the sandwich panel target).